



Environment and  
Climate Change Canada

Environnement et  
Changement climatique Canada

# ECCC seasonal & decadal update

Bill Merryfield

*Canadian Centre for Climate Modelling and Analysis*



Canada

WGSIP 25  
4-8 November 2024

# Seasonal forecasting at ECCC

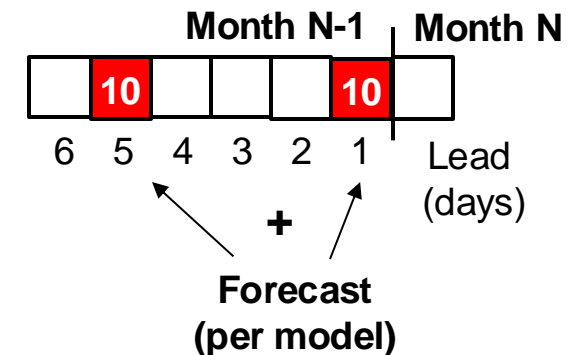
- Unique among national centres, ECCC has always employed **multi-model ensembles** for its seasonal forecasts:

System	Debut	Climate models	NWP models	Ens size	Range
HFP	1996	GCM2	SEF	2×6	3 mon
HFP2	2008	GCM2, GCM3	SEF, GEM	4×10	4 mon
CanSIPS	2011 Dec	CanCM3, CanCM4	-	2×10	12 mon
CanSIPsv2	2019 Aug	CanCM4i	GEM-NEMO	2×10	12 mon
CanSIPsv2.1	2021 Dec	CanCM4i	GEM5-NEMO	2×10	12 mon
CanSIPsv3	2024 Jul	CanESM5	GEM5.2-NEMO	2×20	12 mon

Coupled

HFP = Historical Forecasting Project

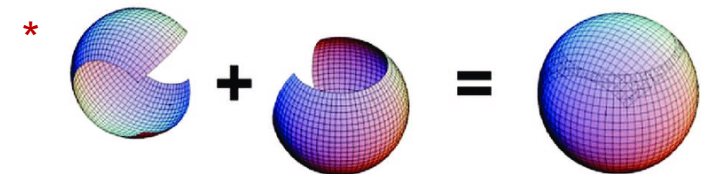
CanSIPS = Canadian Seasonal to Interannual Prediction System



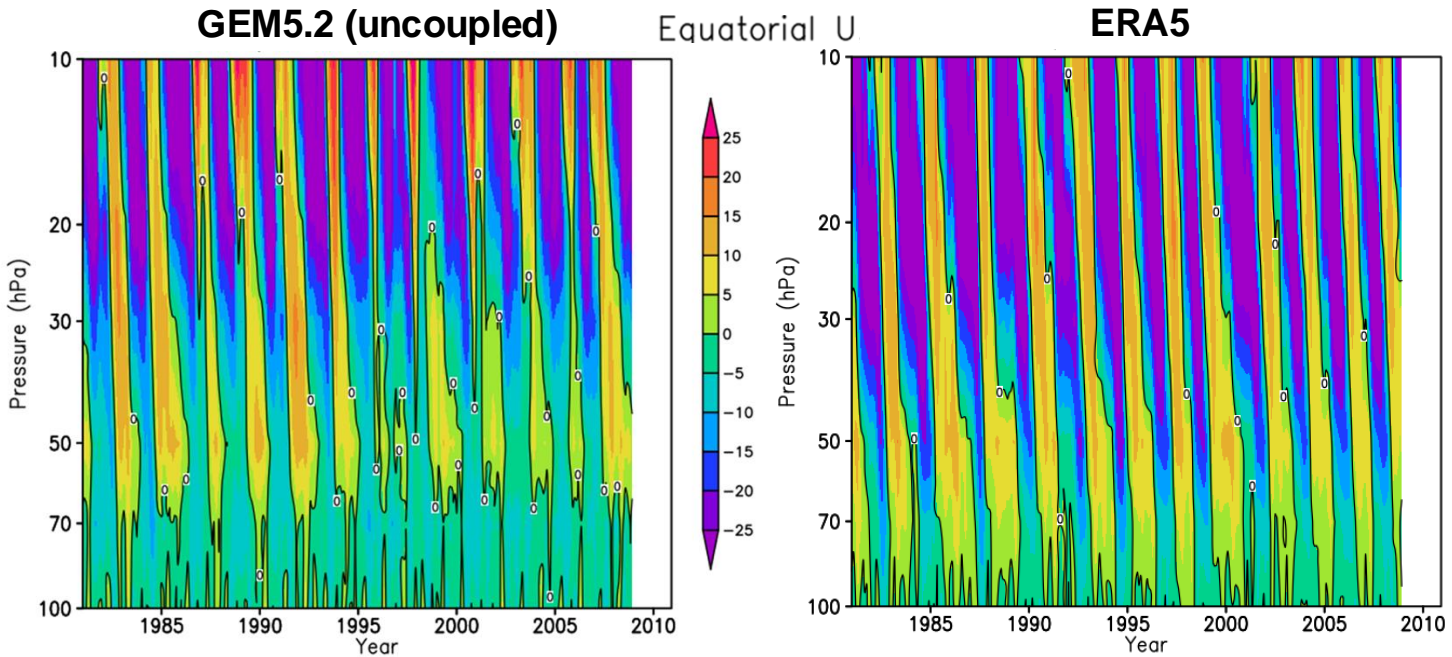
# CanSIPsv3

Component	CanESM5	GEM5.2-NEMO
<b>Atmosphere</b>	CanAM5, T63/L49(1hPa)	GEM5.2, 1° Yin-Yang*/L85(0.1hPa)
<b>Land</b>	CLASS3.6, 3 soil layers	ISBA/SPS, 2 soil layers
<b>Ocean</b>	CanNEMO, ORCA1/L45	NEMO3.6, ORCA1/L50
<b>Sea ice</b>	LIM2	CICE6, 5 categories
<b>Terrestrial ecosystem</b>	CTEM	N/A
<b>Ocean ecosystem</b>	CMOC	N/A

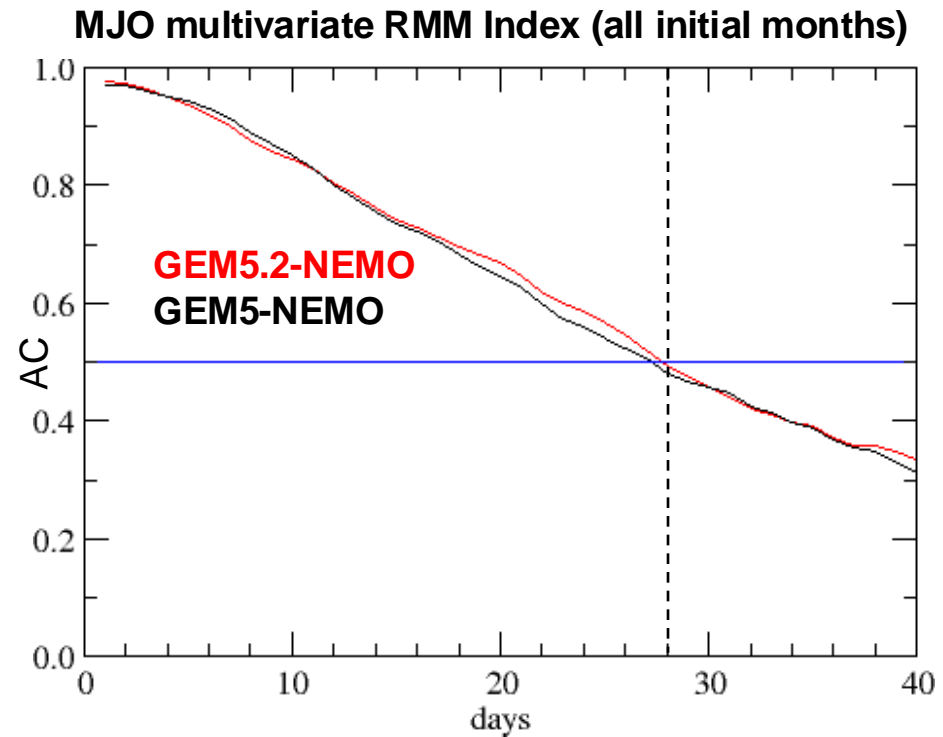
CLASS = Canadian Land Surface Scheme  
CTEM = Canadian Terrestrial Ecosystem Model  
CMOC = Canadian Model of Ocean Carbon



# QBO & MJO in GEM5.2-NEMO



- GEM5-NEMO did not have a realistic QBO
- GEM5.2-NEMO uses adjusted parameters at launching level value for non-orographic gravity waves within  $\pm 10^\circ$  lat
- This results in a **realistic QBO amplitude and period** ( $\sim 28$  mon) in the mid-upper stratosphere
- **QBO less well simulated in the lower stratosphere**

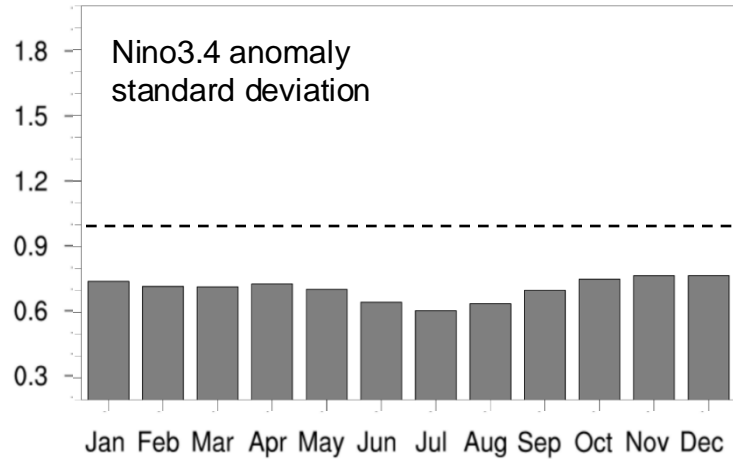


- GEM5.2-NEMO MJO skill similar to GEM5-NEMO
- Anomaly correlation  $\geq 0.5$  for  $\approx 28$  days
- MJO skill much higher than for ECCO subseasonal model ( $\approx 17$  days)

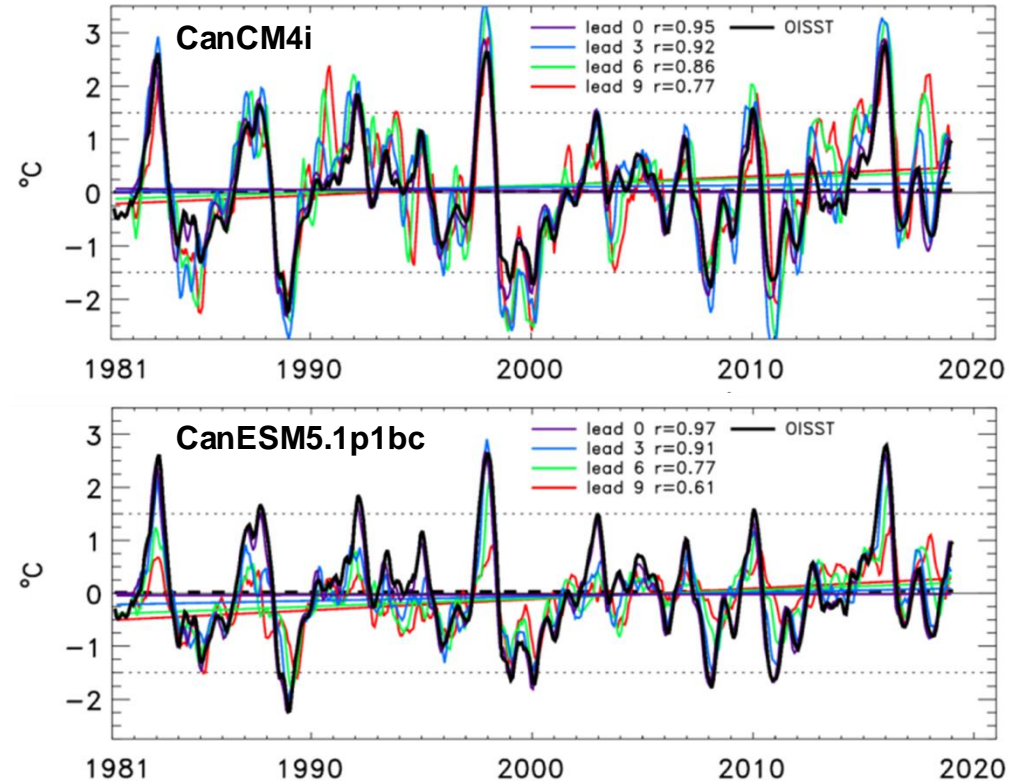
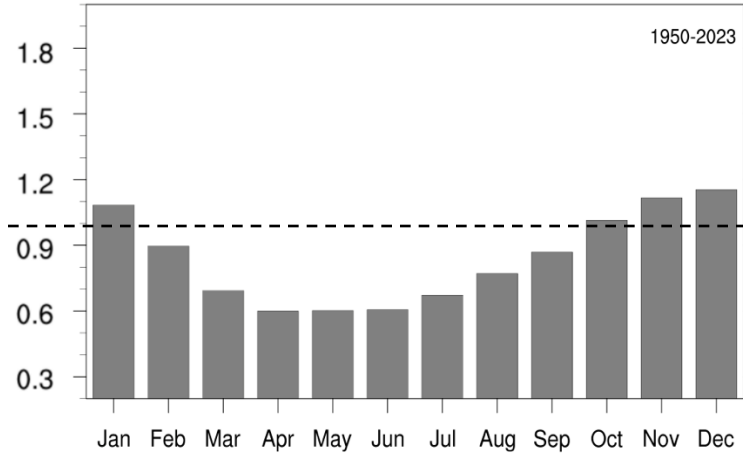
# ENSO in CanESM5.1p1bc

## Nino3.4 vs lead time

### CanESM5 historical run



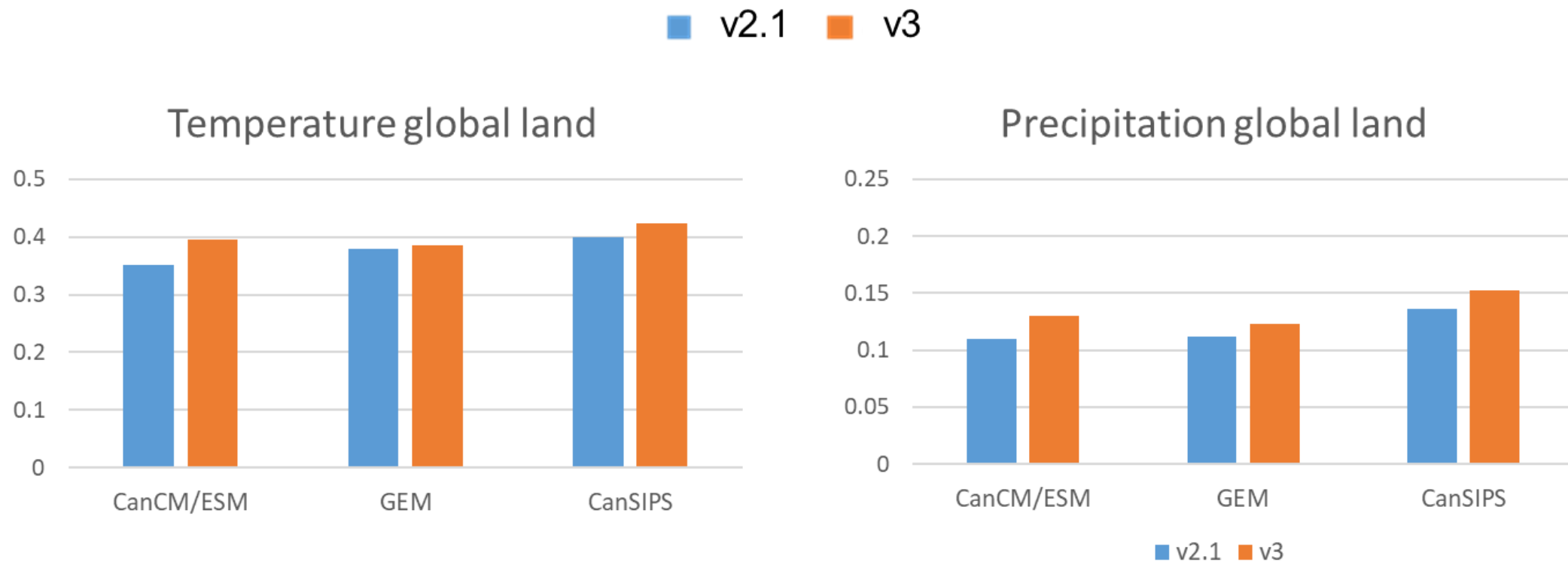
### ERSSTv5



- Freely running CanESM5 biased toward **weak ENSO amplitude and seasonality**
- Translates to relatively low ENSO correlation skill compared to predecessors CanCM4/4i
- Mitigated by reduced incidence of false alarms
- Teleconnections & global skill improved by **online bias correction (Session S5 presentation)**

# Seasonal temperature & precipitation skill

Anomaly correlation averaged over all 12 initial months and 0-9 month lead time  
**20+20 ensemble members for both v2.1 and v3**

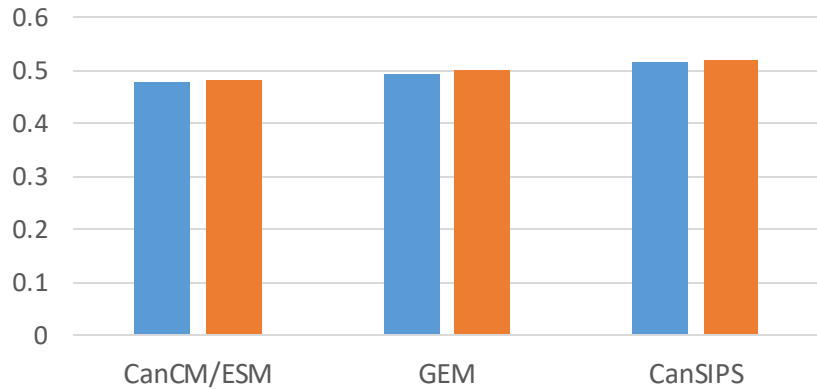


# Seasonal Z500, SST, Niño3.4 skill

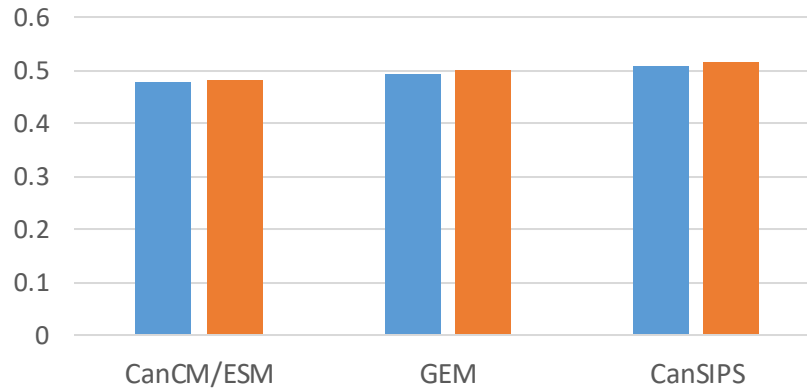
Anomaly correlation averaged over all 12 initial months and 0-9 month lead time  
**20+20 ensemble members for both v2.1 and v3**

■ v2.1 ■ v3

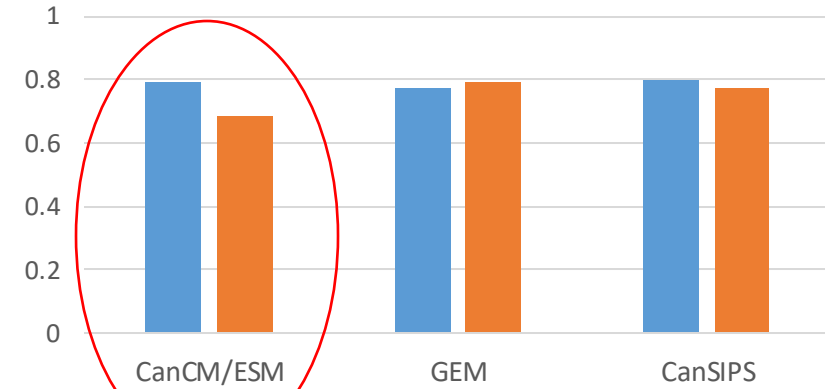
### Z500 global



### SST global



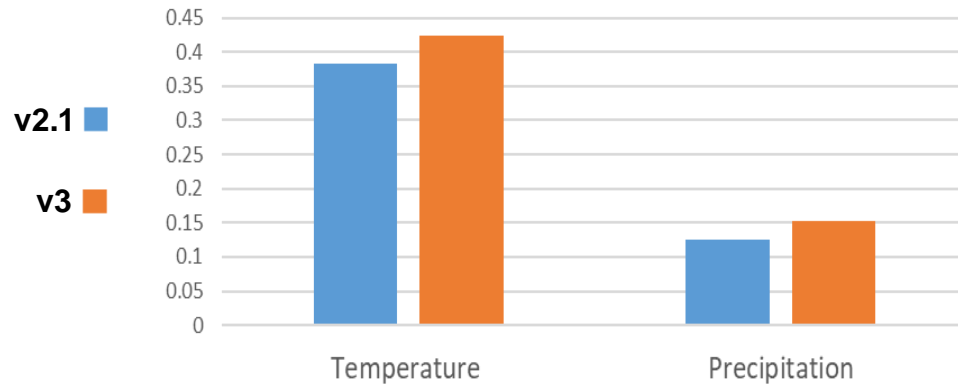
### Nino3.4



# Overall relative performance of CanSIPsv3

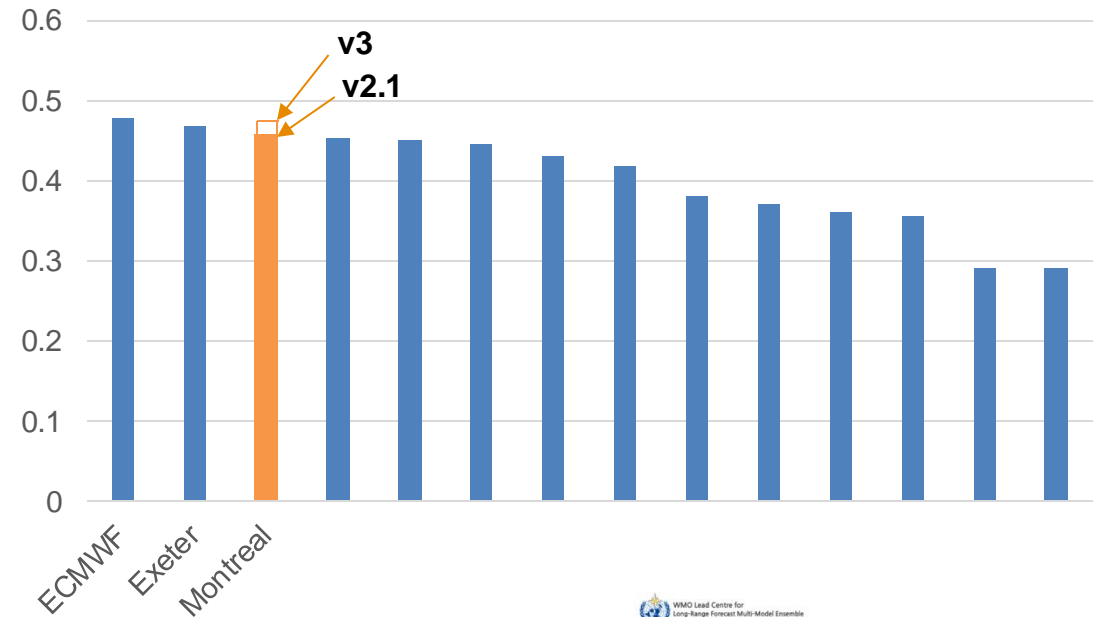
## Compared to CanSIPsv2.1

Mean anomaly correlation skill over global land  
*Averaged over all initial months and lead times*



## Compared to WMO GPCs

Global mean anomaly correlation for 2m temperature  
All initial months 1993-2009



## CanSIPsv3 skill improvement

- ~40% attributable to increased ensemble size
- ~60% attributable to model improvements

<https://wmo.org>





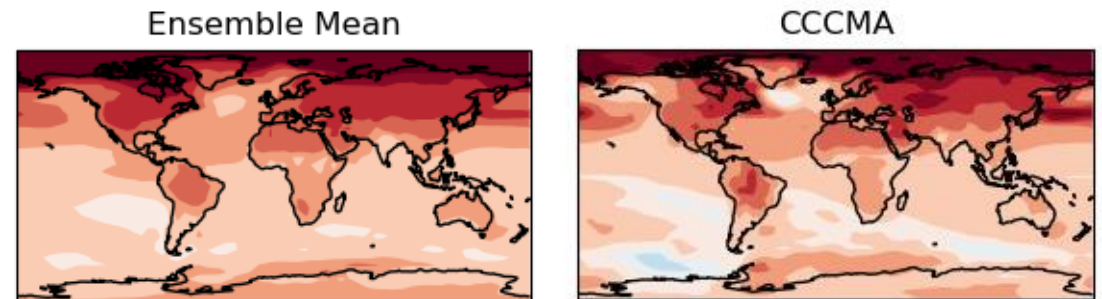
# Toward CanSIPSv4

- **Late 2026** implementation
- **CanESM6** (1° GEM dynamical core, CCCma physics, CLASSIC land, 1/4° NEMO ocean)
- **New GEM-NEMO** (35km GEM dynamical core, RPN physics, SVS land, 1/4° NEMO ocean)
- **ERA6/ORAS6** hindcast initialization?

## Decadal predictions for LC-ADCP

- **2011-2024\*** **CanCM4/4i**
- **2025-2026** **CanESM5.1p1bc**
- **2027-** **CanESM6?**

2023 predictions for 2024-2028 near-surface temperature



\*Year 1 of predictions

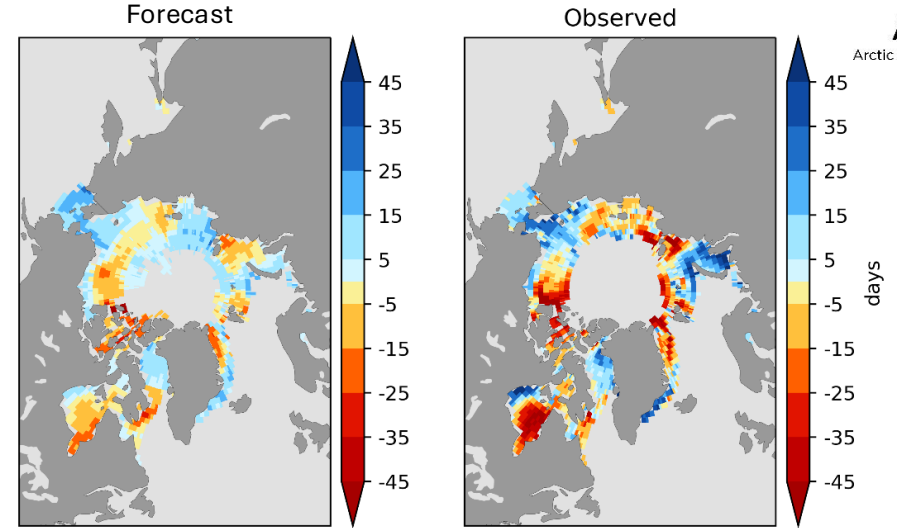
# Sector-relevant product development



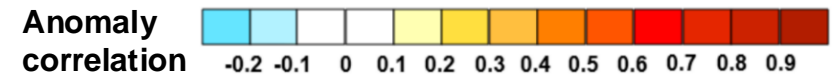
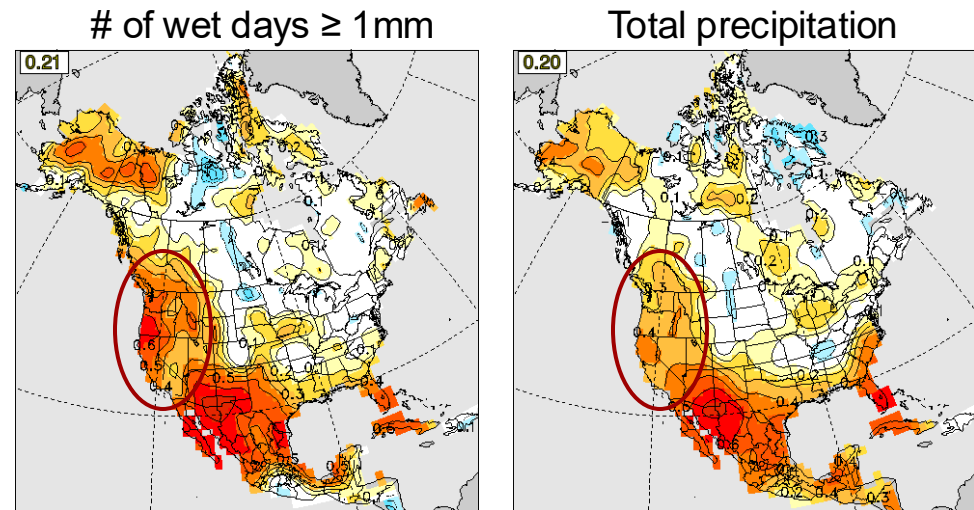
ACF  
Arctic Climate Forum

- Arctic sea ice forecasts →
- Products derived from **high-frequency outputs provided to C3S**, such as **heating/cooling/growing** degree days, **wet days**, hot/cold extremes...
- Collaboration with **Canadian Centre for Climate Services** on product development informed by user engagement

Ice-free date anomaly from 1 May 2024



JFM lead 1 month 1991-2020



<https://climatedata.ca>